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A Manual for Operators of Schools, Private Schools and Day Nurseries with Excess Lead in their Drinking Water

A resource guide on how to locate the source and remedy the problem

Protecting our environment.

Ontario

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An online version of this guide can be found at **www.ontario.ca\drinkingwater**

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Purpose of this resource guide

The Ontario Ministry of the Environment (MOE) is providing this resource guide for operators of schools, private schools and/or day nurseries or the consultants they engage to help them remedy the problem of chronic excess lead in their facilities' drinking water. Ministry experts provided the content. They drew from their own knowledge as well as information and illustrations from the United States Environmental Protection Agency's booklet *3Ts for Reducing Lead in Drinking Water in Schools.*

A message to operators….

As required by regulation under the Safe Drinking Water Act, 2002, you have been sampling and testing your drinking water annually to determine its lead levels. If you have found that the lead concentration in water samples from your facility exceeds 10 µg/L (micrograms per litre) – the maximum acceptable concentration for lead in drinking water in Ontario – this guide provides information that can help you take aggressive steps to correct this problem.

The levels of lead in drinking water that comes from the public water supply is normally well below the maximum acceptable concentration. If there is excess lead in your facility's drinking water, it likely got there by leaching out of the pipes and fixtures in your facility's plumbing and/or the service line. Your facility's specific lead levels may be influenced by the type of plumbing materials as well as the incoming water's corrosiveness (extent to which it can cause a chemical reaction that will dissolve and wear away metal in the pipes) and/or water use patterns within your facility.

This guide includes suggestions on what you can do to locate the source of excess concentrations of lead in your facility's drinking water as well as possible solutions to reduce these excess lead concentrations. All the information and suggestions in this guide are advice, not regulatory requirements.

You and your staff may have the expertise to use this guide and to locate the problem areas within your buildings and service lines without outside assistance. Alternatively, you may choose to engage a plumbing professional to undertake these tasks.

Overview

This guide is for operators of schools and/or day nurseries. It provides and explains a four-step methodology to help them remedy excess lead in their schools' and/or day nurseries' drinking water.

Step 1: Assess your plumbing. You will need to begin by creating a plumbing profile of each building, addition and wing. This profile will help you learn how water enters and flows through the building(s), identify and prioritize places to take water samples, understand whether lead is leaching into the drinking water in specific areas, and enable you to plan, establish and prioritize corrective measures to address your specific lead problems. You can gather the necessary information to create your own plumbing profile by filling in a chart provided in this guide. You will need to know the age of the buildings, the date and type of repairs to the plumbing system, the materials in the pipes and solder, the location and age of the plumbing system's major components, and more.

Step 2: Develop a sampling strategy. The plumbing profile will help you prioritize sampling and testing in areas with lead pipes, areas with lead-soldered joints and areas where plumbing fittings and fixtures that contain lead were used. A systematic approach is recommended:

- Collect an initial sample from all outlets commonly used to obtain drinking water.
- Collect initial service line and watermain samples and compare the results to the above.
- Conduct follow-up flushed sample testing if initial samples reveal lead concentrations greater than 10 µg/L for a given outlet.

Step 3: Execute the sampling strategy and use the test results to remedy the problem. Armed with the sampling strategy, you can begin to collect and test drinking water samples from some or all of the following locations, using the guidelines provided:

- drinking water outlets such as bubblers or drinking water fountains, water coolers and water faucets (taps)
- service line and/or watermain and/or
- interior upstream plumbing such as laterals, headers and riser pipes.

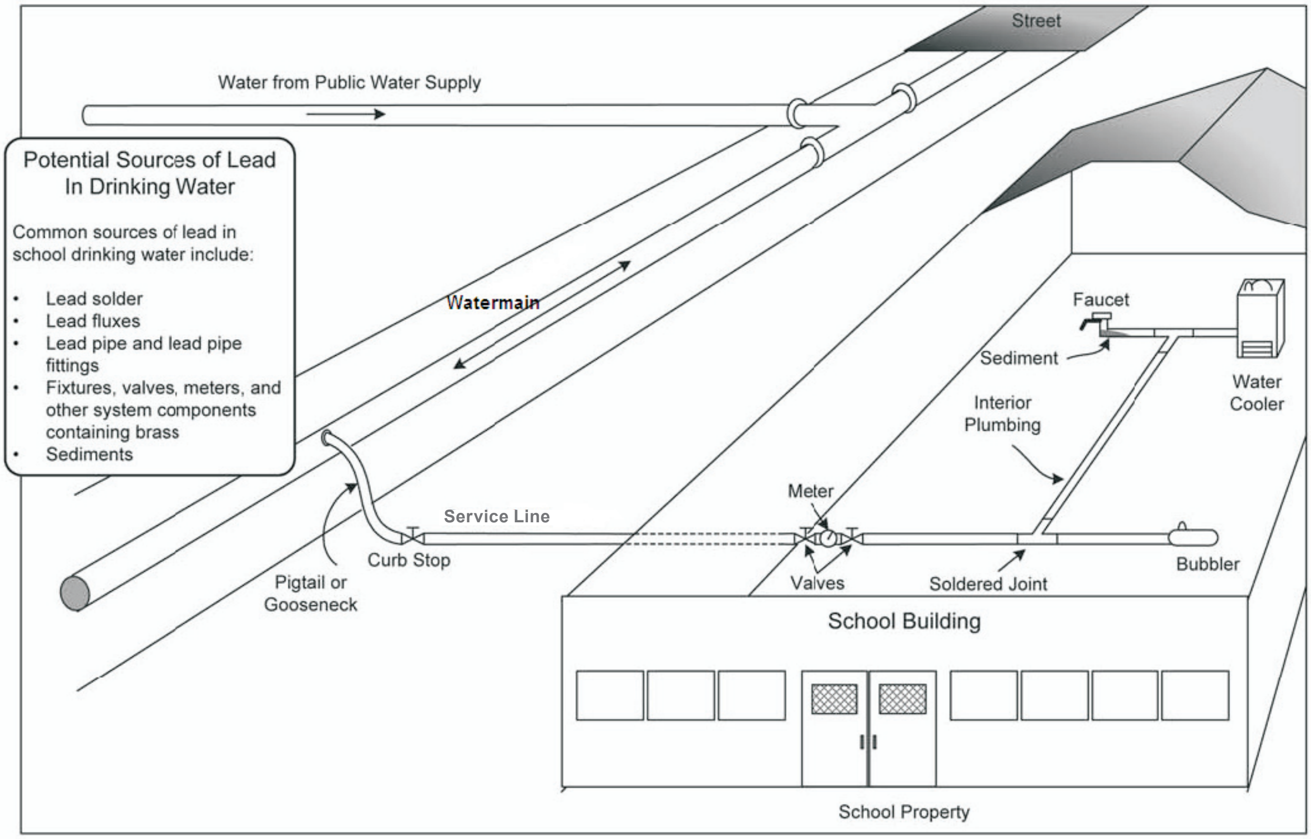
You can then interpret test results according to the guidelines, and with the assistance of the variety of sample scenarios and remedies provided.

Step 4: Take routine, interim and permanent measures. Perhaps a lead problem has been identified, but it is not feasible to immediately put permanent control measures in place. This step includes some routine and/or interim measures you can implement that could reduce lead levels in the water before you can implement more effective permanent measures. It also provides routine control measures that may still be necessary even once your facility has solved its main lead problems, to prevent excessive levels of lead from creeping up again in drinking or cooking water.

Methodology

Every facility is unique. Certain areas of each plumbing system, however, are more likely to cause excess lead concentrations in a facility's drinking water than others. Figure 1 shows you the most common areas you may need to assess.

Figure 1: Potential sources of lead in drinking water


Street
Water from Public Water Supply
Potential Sources of Lead In Drinking Water
Common sources of lead in school drinking water include:
Lead solder
Lead fluxes
Lead pipe and lead pipe fittings
Fixtures, valves, meters, and other system components containing brass
Sediments
Watermain
Faucet
Sediment
Water Cooler
Interior Plumbing
Meter
Service Line
Curb Stop
Pigtail or Gooseneck
Valves
Soldered Joint
Bubbler
School Building
School Property

Step 1: Assess your plumbing

The importance of a plumbing profile

A plumbing profile of each building, including each addition and wing, will help you determine how to proceed. It will make it easier to:

- understand how water enters and flows through your building(s)
- identify and prioritize places where you should take water samples
- understand whether you have a widespread problem or only specific areas that may be leaching lead into your drinking water
- plan, establish and prioritize corrective measures to address lead problems in your facility.

Conducting a plumbing assessment survey for your facility

The following chart is a plumbing assessment survey. It shows you the questions you can ask or the actions you can take to create your facility's plumbing profile. It also provides background information on the rationale for these questions and actions. Appendix 4 provides a blank survey you can fill in for your facility. You will need to have a facility plumbing map on hand to answer all the questions.

These questions/actions will help you pinpoint the source of the lead	Why these questions/actions are important
1. Was your original building constructed before January 1990? Does your building still have and use all or parts of its original plumbing? Have any parts of the building's plumbing infrastructure been replaced? Were any buildings or additions added to your original facility?	If your building was constructed before January 1990, its pipes may have lead in them. Or it may have copper plumbing pipes soldered together with lead joints. Either way, there may be a coating of mineral deposits (the technical term for this is passivation) on the inside of your building's water pipes. They are a result of the water's natural mineral content and/or the efforts of your public water supplier over the years to minimize the corrosiveness of the water. This coating forms a barrier between the water and the plumbing material, and results in decreased lead levels in water. If no coating has formed or there are breaks in the coating, your drinking water may be in direct contact with lead in the plumbing system.
2. Was your building built or repaired after 1990? If so, what type of pipes and solder were used? Were they lead-free (pipes, pipe fittings, fixtures not more than 8% lead; solder and flux not more than 0.2% lead)?	The December 1989 amendment to the Ontario Building Code requires "lead-free" pipes, pipe fittings, and fixtures (not more than 8% lead) and "lead-free" solder and flux (not more than 0.2% lead). Newer buildings constructed after December 1989 are less likely than older buildings to have lead pipes in their plumbing systems, and their joints are likely soldered together with lead-free solders. However, it is likely that high-lead solder and fluxes continued to be used after December 1989 in some areas of the province. "Lead-free" pipes, pipe fittings and fixtures hold less potential for leaching lead, but it is still possible. The lead leaching potential of "lead-free" (i.e., tin-antimony) solder is much lower than for lead solder. In addition, lead leaching can still occur even if lead-free materials were used in new construction and/or plumbing repairs. If "lead-free" materials were not used in new construction and/or plumbing repairs, your building's drinking water could have elevated lead levels. If there is also no passivation of the plumbing material, lead in your plumbing could be in direct contact with the drinking water flowing through your system, and could end up in the water, especially if the water is corrosive.

3. Have you had plumbing repairs within the past five years? If so, when and where? Was lead soldering used for these repairs?	If lead solder was used in the piping installation, or if plumbing repairs in your building (or an addition, new plumbing or repair) are less than five years old, you may have elevated lead levels. Even in lead-free repairs, corrosion can occur after plumbing repairs. As indicated on previous page, corrosion is a technical name that describes a chemical reaction between water and pipes or between copper and solder. Corrosion between copper and solder is a metal-to-metal reaction known as galvanic corrosion, and it can be particularly strong in new piping for the first five years. After the first five years – and assuming the water is non-corrosive – passivation (a coating of mineral deposits on the inside of the pipes) is likely to occur, which reduces opportunities for lead to get into the water.
4. What is the composition of potable water pipes serving your facility? Write down the location of each different type of pipe, the direction that water flows through the building from that pipe, the areas of the building that receive the water from those pipes first, and the areas that receive that water last.	Different types of pipes have different potential levels of lead. Most buildings have a combination of different plumbing materials: • Lead pipes are a major source of lead contamination in drinking water. • Galvanized metal pipes may have compounds containing lead to seal the threads joining the pipes. Debris from this material, which has fallen inside the pipes, may be a source of contamination. • Copper pipe joints were typically joined together with lead solders prior to January 1990. • Plastic pipes, especially those that do not meet NSF International Standards (see Appendix 3 for information on how you can meet NSF standards) or have been manufactured abroad, may contain lead. Determining the direction of water flow through every type of pipe and the areas of your facility that receive that water will enable you to select sampling locations for upstream testing to pinpoint the source of lead in water from a particular tap.
5. Do you have tanks in your plumbing system, such as pressure or gravity storage tanks? If so, note their location and any available information, such as manufacturer and date of installation.	The inside coating of some older tanks can be high in lead content. The inside of the tanks can accumulate sediment that could be flushed back into the plumbing system under certain circumstances. You may wish to or need to: • contact the supplier or manufacturer to obtain information about coatings • hire a plumber or tank service contractor to inspect your tanks, especially gravity storage tanks located outside the building.

6. Do you have brass or bronze fittings, faucets, or valves in your drinking water system? Mark the locations on your facility map, with notes for future analysis of lead sample results.	If faucets, valves, and fittings made of brass or other lead-containing alloys were installed, lead levels in the water may be high. Brass is composed primarily of copper and zinc. Bronze is composed primarily of copper and tin. Both can contain two to eight per cent lead, which is considered lead-free. Older brass faucets and fittings, however, may contain higher percentages of lead in their interior construction, which can pose contamination problems. In addition, during the production of brass or bronze fittings and fixtures, lead can be smeared on their water contact surfaces. The degree to which lead will leach from brass/bronze products containing less than eight per cent lead depends on the corrosiveness of the water and the manufacturing process used to develop the product. According to one study, fabricated faucets tend to contribute less lead to the water than faucets manufactured by the permanent mold process, regardless of the amount of lead in the alloy.
7. Note on your facility map the number and locations of any of the following outlets that provide water for consumption: • kitchen taps • drinking fountains or taps • washroom taps that permit users to obtain cold water.	You need to identify the locations of all of these specified outlets, not just those known to include lead components. This is because lead solders or lead in the brass fittings and valves used in some taps, bubblers, and refrigerated water coolers (in addition to lead components in the plumbing system), may be sources of lead.
8. Where does the water service line (the pipe that carries drinking water from a public watermain to your facility) enter your building and connect to the interior plumbing? Is the service line made of lead?	It's important to know the location and composition of your service line. Lead piping was often used for the service lines that connect buildings to public water systems. Although a protective layering of minerals may have formed on these pipes, vibrations could have caused this protective buildup to flake, and for lead to enter your drinking water. If the service line is made of lead, it could be leaching this lead into your drinking water. However, if the service line is not a lead pipe, it still may have a lead gooseneck (a curved pipe connecting service line to the watermain) or other materials containing lead.

9. Note, on your facility map, the locations of all outlets with screens or aerators (they are accessible on standard faucets), and whether these screens or aerators have been cleaned. Is there is a regular maintenance schedule for cleaning these screens? What is it? Are particles and other materials often found on these screens?	Lead-containing particles trapped on screens/aerators can be a source of lead contamination, or an indication that there is particulate lead in the water. The particles and other materials that collect on screens can be sources of additional lead contamination. It is a good idea to create and implement a routine maintenance program to clean the screens/aerators frequently.
10. Note, on your facility map, the locations of any signs of corrosion, such as frequent leaks or fixture staining. Also note, on your facility map, the locations where there have been complaints of stains on laundry or dishes.	Frequent leaks, rust-coloured water, and stains on fixtures, dishes, and laundry are signs of corrosive water. Green deposits on pipes and sinks indicate copper corrosion; brown stains result from the corrosion of iron. Where such symptoms occur, high levels of lead, copper, and iron may be present in the water. Also, lead can accumulate with iron, which can form hard-to-remove deposits.
11. Note, on your facility map, the locations of any electrical equipment grounded to water pipes.	If electrical equipment such as a telephone has been installed using water pipes as a ground, the electric current travelling through the ground wire could accelerate the corrosion of any interior plumbing containing lead.
12. Have there been any complaints about bad (metallic) taste or rust-coloured water? If so, note the locations.	Although you cannot see, taste, or smell lead dissolved in water, the presence of a metallic taste or rusty appearance may indicate corrosion and possible lead contamination.
13. Do you have any known plumbing issues such as dead-ends, low use areas or other problem areas? Are you planning renovations for part or all of the plumbing system?	This is important information for your decisions on sample locations and sampling protocol.

Step 2: Develop a sampling strategy

Before you take this step, it is important that you have been testing your lead annually as required by regulation under the Safe Drinking Water Act, 2002. It is also important that you have completed Step 1 of this guide to create your own plumbing profile. Your plumbing profile, combined with the systematic testing described below, will help you develop a sampling strategy.

Put your plumbing profile to work

Your plumbing profile will be the backbone of your strategy for sampling and testing to identify the sources of lead in your facility's drinking water. It should tell you:

- if and where lead pipes are used in your facility
- if water corrosiveness is a likely reason for your problem
- if and where your building has brass fittings, faucets, and/or valves
- if and where lead solder was used in the installation of your building's plumbing
- if your facility's service line (i.e., the pipe that carries water from the public water system or private well to the building) is made of lead pipes.

This information can help you prioritize sampling and testing, and focus on those areas most likely to be the source of lead contamination within your facility.

A systematic approach to your sampling strategy

The lead concentrations between and among individual outlets can vary substantially due to differences in flow rates and/or plumbing materials. To identify the source of lead in the water from certain outlets, it may therefore suffice to conduct selective upstream testing of only outlets in the direct line between the watermain in the street and those outlets that have excessive lead levels (found in previous tests).

In general, however, systematic testing of your facility's entire plumbing in the following order will help you pinpoint the exact location(s) from which excess lead is getting into your facility's drinking water:

- **Collection of initial first draw samples from all outlets commonly used to obtain drinking water in your facility,** including the outlets you tested as part of the regulatory sampling, kitchen taps, water bubblers and fountains, all washroom taps of a type from which it is possible to obtain cold water, and so on. These samples will help you determine the lead content of water sitting in water outlets used for drinking or cooking within your facility. They will also enable you to compare the lead level in water that has remained stagnant for six hours or longer in an outlet or fixture to lead levels in water from your facility's service line and water from the watermain to which the service line is connected.

- **Collection of initial service line and watermain flushed samples.** The service line sample should come from a tap located as near as possible to the location where your facility's internal plumbing is connected to its service line. To ensure that your sample represents water in the service line in the public water system or at the location where your facility is connected, take both samples immediately after you have flushed the tap for the time specified in Appendix 2.

- **Comparison of all the initial sample results** to determine what specific contributions your service line and your watermain are making to lead concentrations at your facility's taps, and if there is need for further testing.

- **Follow-up interior plumbing flushed sample testing.** This is necessary if your initial samples reveal lead concentrations greater than 10 µg/L for a given outlet and the concentrations coming from the service line and watermain do not account for all of the lead found in the initial first draw samples. Comparison of your initial and follow-up sample test results will help you assess whether the lead contamination results are from the fixture (outlet) itself or from interior plumbing. You may need to take additional follow-up samples from the interior plumbing within the building to further pinpoint the sources of lead contamination.

You will be able to use your findings from the above approach to remedy the problem, likely by replacing one or more outlets or other parts of your plumbing system. If you need to replace fixtures or any other drinking water system products, you will need to make sure they are NSF compliant or have ANSI 61 certification (Appendix 3 provides information on how to meet NSF standards).

Once you have tried the remedies suggested in this guide, always retest the water to confirm that they have worked.

Step 3: Execute your sampling strategy and use the test results to develop remedies for the problems

Armed with your sampling strategy – and after you have repaired any leaking outlets to ensure that you can collect representative samples – you can begin to collect and test drinking water samples, interpret test results and develop remedies. Your sampling strategy should take you from testing at outlets to systematically working through your facility's interior plumbing all the way to its service line, if necessary.

This section provides detailed information on how and where to collect your samples and analyze your results.

How to collect water samples

When collecting samples or flushing a tap prior to sample collection (where flushing is required), open the tap to produce a small (i.e., pencil-sized) steady flow of water. DO NOT begin with a high rate of flow and then reduce it before you take your sample. The sudden change in flow could stir up sediments or cause sloughing of pipe films that would not be characteristic of typical water use patterns.

All water samples you collect should be 250 millilitres (mL) in volume. This relatively small-sized sample represents a small section of plumbing and can therefore more effectively identify the location of lead sources than a larger sample. A 1,000 mL (1 litre) sample would include all the valves, tees and elbows and soldered joints of a relatively long line of plumbing.

Assign a unique, specific sample identification number to each sample you collect. The numbering system for the illustrative samples in this guide was developed to make the directions in this guide easy to understand. You will need to develop your own sampling plan schematic or numbering system, and record each identification number on a sample bottle and on a record-keeping form.

Use a two-action sampling process. Lead in a water sample taken from an outlet can originate from:
- the outlet fixture (faucet, bubbler, etc.)
- plumbing upstream of the outlet fixture (pipe, joints, valves, fittings, etc., including the service line from the watermain to the building) or
- the water entering your facility/property.

The following protocol will help you learn which is or are the actual source(s) of lead in your water:

Action 1a: Initial sampling of outlets or first draw samples. Because lead concentrations can change as water moves through a plumbing system, the best way to start identifying the source of elevated lead in drinking water at your school or day nursery is to test the water from various taps within the building(s). As discussed above, these include kitchen taps, water bubblers and fountains, and washroom taps that run cold water. Make sure to take these samples before your facility opens, after the water has been sitting in the pipes for at least six hours, i.e., before any flushing or water use that day on the branch of plumbing that serves the outlet. Collect these water samples immediately after opening the valve, without allowing any water to run into the drain.

Action 1b: Initial service line and watermain flushed samples. The service line sample should come from a tap located as near as possible to the location where your facility's internal plumbing is connected to its service line. To ensure that your sample represents water in the service line in the public water system or at the location where your facility is connected, take both samples immediately after you have flushed the tap for the time specified in Appendix 2.

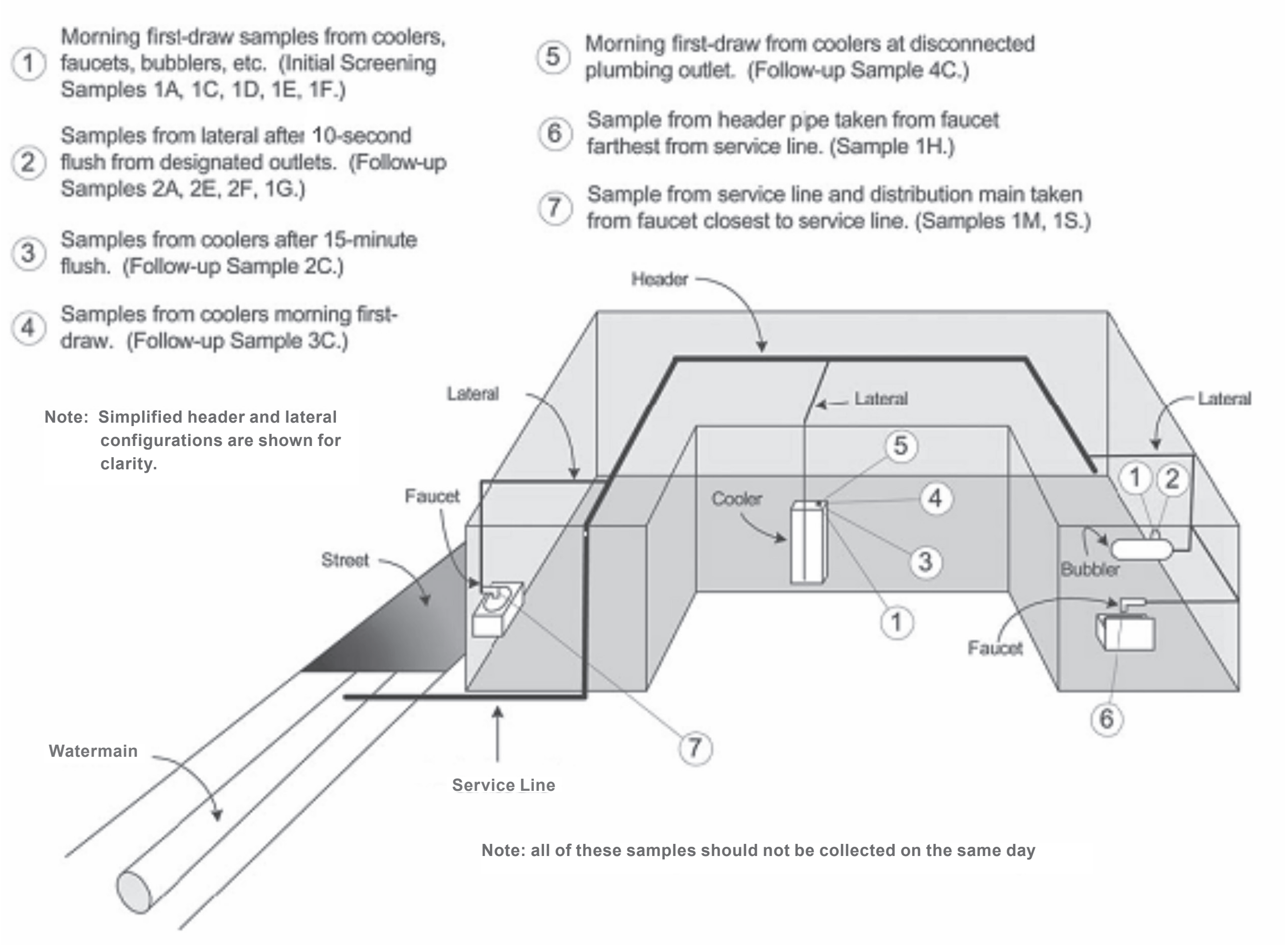
Action 2: Follow-up flushed samples. As when you collected initial first draw samples, you must take follow-up flushed samples before your facility opens and before it has used any water from the outlets you are testing. Where this is not possible, make sure that at least the branch of plumbing serving that tap has not been used. Make sure to collect the flushed samples immediately after the water has run from the outlet for at least 10 seconds, not immediately after opening the tap. This will ensure that you are testing the lead content in the water from the plumbing directly behind the wall.

Where to collect water samples and how to do the sampling

As indicated above, it is important that you begin by testing the drinking water at your outlets. These results will help you decide whether you need to test the appropriate interior plumbing and, based on these findings, your service line and watermain. You will likely need to collect and test water from the following locations, in the following order:
- drinking water outlets such as bubblers or drinking water fountains, water coolers and water faucets (taps)
- interior upstream plumbing such as laterals, headers and riser pipes and/or
- service line and/or watermain.

Figure 2 is a simplified diagram of the interior plumbing in a single-level building showing the location of and sampling protocol for these major plumbing system components. It includes the sample locations discussed in detail later in this guide. Figure 3 (page 12) shows the location of and sampling protocol for these components in a multi-level building, and likewise illustrates the sample locations discussed in detail further on in this guide.

Figure 2: Plumbing configuration for a single-level facility



① Morning first-draw samples from coolers, faucets, bubblers, etc. (Initial Screening Samples 1A, 1C, 1D, 1E, 1F.)

② Samples from lateral after 10-second flush from designated outlets. (Follow-up Samples 2A, 2E, 2F, 1G.)

③ Samples from coolers after 15-minute flush. (Follow-up Sample 2C.)

④ Samples from coolers morning first-draw. (Follow-up Sample 3C.)

⑤ Morning first-draw from coolers at disconnected plumbing outlet. (Follow-up Sample 4C.)

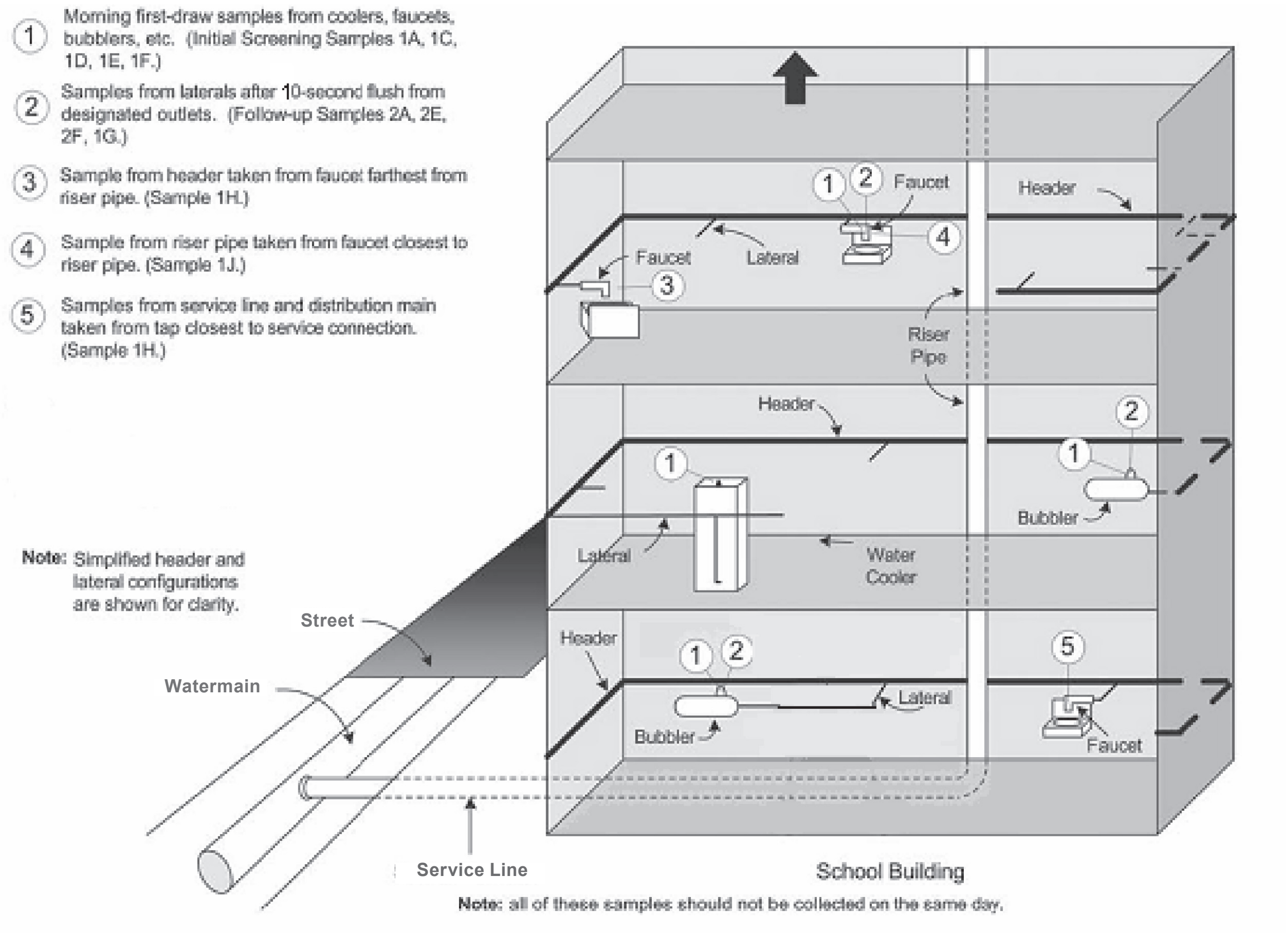
⑥ Sample from header pipe taken from faucet farthest from service line. (Sample 1H.)

⑦ Sample from service line and distribution main taken from faucet closest to service line. (Samples 1M, 1S.)

Note: Simplified header and lateral configurations are shown for clarity.

Note: all of these samples should not be collected on the same day

Figure 3: Plumbing configuration for a multi-level facility



① Morning first-draw samples from coolers, faucets, bubblers, etc. (Initial Screening Samples 1A, 1C, 1D, 1E, 1F.)

② Samples from laterals after 10-second flush from designated outlets. (Follow-up Samples 2A, 2E, 2F, 1G.)

③ Sample from header taken from faucet farthest from riser pipe. (Sample 1H.)

④ Sample from riser pipe taken from faucet closest to riser pipe. (Sample 1J.)

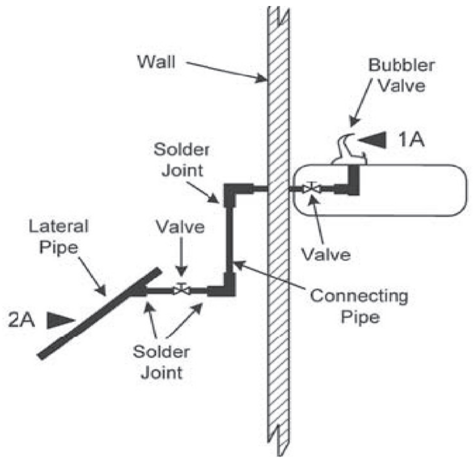
⑤ Samples from service line and distribution main taken from tap closest to service connection. (Sample 1H.)

Note: Simplified header and lateral configurations are shown for clarity.

Note: all of these samples should not be collected on the same day.

Drinking water outlets

Figure 4: Bubblers or drinking water fountains and sample locations 1A and 2A



The protocol for collecting initial first draw and follow-up flush samples varies by type of drinking water outlet. The instructions below for sampling at water outlet locations are also applicable for the sampling from upstream interior plumbing, service lines and the watermain serving your buildings.

Bubblers or drinking water fountains (without central chillers), where water is supplied to the bubbler or fountain directly from the building's plumbing (see Figure 4).

Before you collect this sample, do not close or adjust the shut-off valves to the water fountain to prevent their use. Minute amounts of scrapings from the valves will produce inaccurate results showing higher than actual lead levels in the water.

Initial first draw screening sample from Location 1A: Collect Sample 1A (see Figure 4) immediately after opening the valve, without allowing any water to run into the drain – before your facility opens and before any water is used on the plumbing branch (lateral) serving this fountain. This sample is representative of drinking water at the beginning of the day, or after several hours when the fountain has not been used. It is water that has been in contact with the bubbler valve, fittings and the section of plumbing closest to the outlet of the unit.

If the test result indicates a lead level over 10 µg/L, take a follow-up flushed sample from Location 2A of this bubbler: Collect Sample 2A (see Figure 4) after the water from the fountain has run for 15 seconds. This sample is representative of the water in the plumbing, upstream from the point where the bubbler's connecting pipe joins the plumbing lateral (back toward the service line and the watermain). If several bubblers are served by the same plumbing lateral (branch), take samples from different bubblers on different days.

Interpreting the test results

If the lead level in Sample 1A is higher than that in Sample 2A: the bubbler and/or the plumbing immediately upstream from the bubbler contributed a portion of the lead in the drinking water.

If the lead level in Sample 2A is very low (less than 5 µg/L): the bubbler contributed most or all the lead in the water; the water picked up very little lead from plumbing upstream from the outlet.

If the lead level in Sample 2A exceeds 10µg/L: the plumbing upstream from the bubbler also contributed lead in the drinking water.

If the lead level in Sample 2A exceeds 20 µg/L: collect follow-up flushed samples from the header or loop supplying water to the lateral to locate the source of the contamination.

Sample scenario and remedy

☑ **The lead level in Sample 1A (31 µg/L) exceeds that of Sample 2A (7 µg/L):** 24 µg/L of lead is contributed from the bubbler and/or its connecting pipe.

☑ **The lead level in Sample 2A (7 µg/L) does not significantly exceed 5 µg/L:** the bubbler and/or its connecting pipe is contributing most of the lead in the water; very little lead is being picked up from the plumbing upstream from the bubbler.

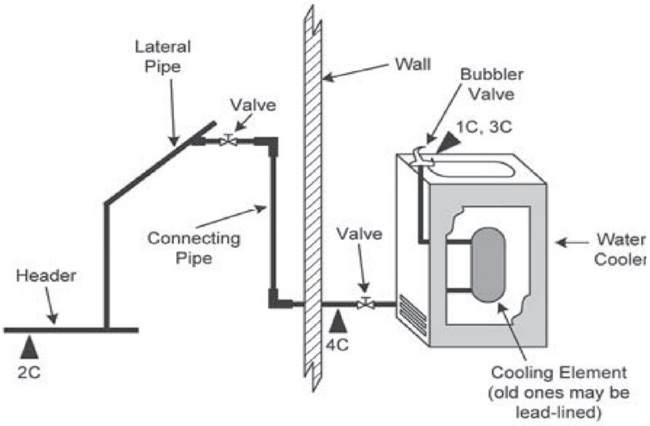
☑ **The lead level in Sample 2A (7 µg/L) does not exceed 20 µg/L:** sampling from the header or loop supplying water to the lateral is not necessary.

Possible remedy: Replace the fixture (bubbler) as well as the associated connecting pipe, valves, and fittings, with lead-free devices, fittings and materials.

Drinking water fountains: Water coolers (see Figure 5)

There are two types of water coolers: all-mounted and freestanding. They are both supplied by water from the building's plumbing and equipped with their own cooling and storage systems. Water coolers store water in a pipe coil or in a reservoir. Refrigerant coils in contact with these storage units cool the water.

Figure 5: Water cooler fountain and sample locations 1C, 2C, 3C and 4C



Note: The valve shows upstream of the water cooler may be located inside the cooler.

Lead in the water from these devices could come from:

- the internal components of the cooler, including a lead-lined storage unit
- the section of the pipe connecting the cooler to the lateral pipe and/or
- the interior plumbing of the building.

Initial first draw screening sample from Location 1C: Take Sample 1C (see Figure 5) immediately after opening the valve, and without allowing water to run into the drain. If the fountain is infrequently used, you can take this sample at any time of the day, so long as the water has not been used in more than six hours. Sample 1C is water that people drink at the beginning of the day or after six or more hours of non-use of the cooler in the morning, i.e., after a night of non-use. It consists of water that has been in contact with the cooler's interior piping, the valve and fittings, the storage unit, and the section of plumbing connecting the cooler to the plumbing lateral.

If the test result indicates a lead level over 10 µg/L, take a follow-up flushed sample from Location 2C: Take Sample 2C (see Figure 5) after your facility closes, and, to ensure that you are not testing stagnant water that has been left in the storage unit, after you have run the water for at least 15 minutes. It is representative of the water that is in contact with the plumbing's header or riser pipe upstream of the cooler.

Take the follow-up flushed Sample 3C (see Figure 5) from this water cooler the next morning immediately after opening the valve, before your facility opens and before any water is used on the plumbing branch (lateral) serving this cooler. Because the water in the cooler was flushed the previous afternoon, this sample is representative of the water that was in contact with the cooler overnight, but not in extended contact with the plumbing upstream.

Interpreting the test results

If the lead level in Sample 3C is greater than in Sample 2C, the water cooler may be contributing lead.

If the lead level in Sample 3C is greater than in Sample 2C, and Sample 1C is greater than Sample 3C, then the upstream plumbing and/or the service line, in addition to the cooler, may also be contributing lead.

If the lead level in Sample 2C is close or equal to that in Sample 3C, then the water cooler is probably not contributing lead.

If the lead level in Sample 1C is greater than that in Sample 3C, and Sample 2C is close or equal to Sample 3C, then the upstream plumbing is probably contributing lead.

If the lead level in Sample 2C is greater than 10 µg/L and is greater than or equal to that in Sample 1C and Sample 3C, the source of lead may be dislodged sediments or other particulate matter in the cooler storage tank, screens, or the plumbing upstream from the cooler.

To determine whether or not the cooler itself is the source of lead, you will need to take a follow-up first draw Sample 4C (see Figure 5). The day before you take this sample, turn off the valve leading to the cooler. Look for and remove any screens at the inlet or bubbler outlet. If you find any debris on these screens, in the pipe, or at the outlet, send a sample to a licensed laboratory for analysis. If your cooler has a drain valve at the bottom of the water reservoir, sample water from the bottom of the water reservoir and analyze any debris. Then, on the day you are taking this sample, clean and flush the plumbing outlet, then collect this sample from the connected plumbing outlet in the same manner as you collected Sample 1C. This sample is representative of the water that was in contact with the cooler overnight, but not in extended contact with the plumbing upstream.

Here is how to interpret the results:

- **If the lead level in Sample 4C is less than 5 µg/L:** the cooler is likely an older one; lead in the other samples is coming from its cooling element, or from debris in the cooler or on the cooler's screens.

- **If the lead level in Sample 4C is much greater than 5 µg/L and less than in Sample 1C:** the source of lead could be the cooler (from its cooling element, debris inside it and/or from its screens) and/or upstream plumbing.

- **If the lead level in Sample 4C is close or equal to Sample 1C:** the cooler is not the problem; all the lead comes from your plumbing.

Sample scenarios and remedies

Example 1:

☑ The lead level in Sample 1C is 54 µg/L: the plumbing upstream from the cooler (anywhere up stream, including the building's service line) and/or the water cooler is contributing lead.
☑ The lead level in Sample 3C (40 µg/L) exceeds that of Sample 2C (5 µg/L): the water cooler is contributing 35 µg/L of lead.
☑ The lead level in Sample 3C (40 µg/L) exceeds that of Sample 2C (5 µg/L), and the lead level in Sample 1C (54 µg/L) exceeds that of Sample 3C (40 µg/L): the plumbing upstream from the cooler (anywhere upstream, including the service line) is contributing 14 µg/L of lead.

Possible remedy: Replace the cooler with one that contains lead-free components and retest the water; locate and eliminate the source of lead in the plumbing.

Example 2:

- ☑ **The lead level in Samples 1C (44 µg/L), 3C (42 µg/L) and 2C (41µg/L) are approximately equal:** the likely source of the lead is neither the cooler nor the plumbing immediately upstream of the cooler (including the plumbing lateral).
- ☑ **The lead level in Sample 4C (43µg/L) significantly exceeds 5 µg/L:** the plumbing upstream from the cooler is the source of lead.

Possible remedies: If the water continues to test high, the header, building's service line and/or public water supply may be the problem. You will need to test them all to determine which is responsible. If you identify the source of lead in plumbing pipe upstream between the header and cooler, replace it with lead-free materials and retest the water for lead.

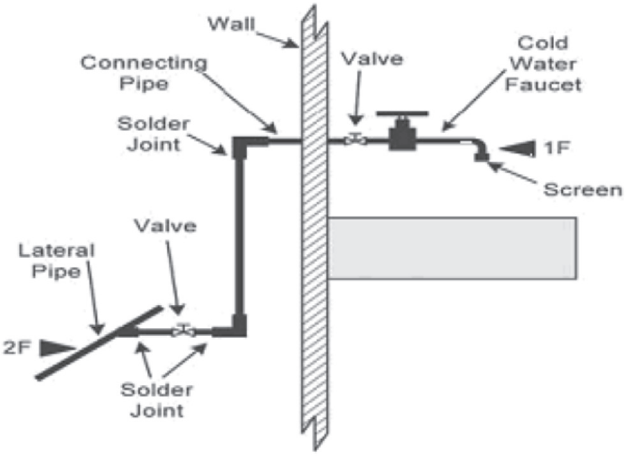
Water faucets (Taps) (see Figure 6)

Initial first draw screening sample 1F (see Figure 6): Collect this water sample from the cold water tap (or the cold water setting in an adjustable dual line faucet) immediately after opening the faucet, without allowing any water to run into the drain. You must take this sample before your facility opens and before any water is used on the plumbing branch (lateral) serving this tap.

This sample is representative of the water that people might drink at the beginning of the day or after the tap has not been used for several hours. It consists of water that has been in extended contact with the fixture and the plumbing connecting the faucet to the lateral pipes.

If your facility has a routine maintenance program, encompassing periodically removing, cleaning, and replacing aerators, you can continue this program, including post-replacement flushing of the tap, before sampling but not less than six hours before you take the first-draw Sample 1F. This is to ensure that you are taking a true first-draw sample.

Figure 6: Water faucet (Tap) and sample locations 1F and 2F



Note: One cause of high lead levels could be recent repairs, dislodged sediment or other debris in the plumbing. If cleaning is performed, any debris is found on tap screens/aerators at the time should be sent to a licensed laboratory for analysis for lead.

If the first-draw sample test result from a faucet indicates lead levels of over 10 µg/L, take a follow-up flush Sample 2F (see Figure 6) from that water faucet: take a sample before your facility opens and before any water is used in the building. Let the water from the faucet run for 10 seconds before collecting the sample. If you cannot ensure that no water is used in the building before you take this sample, make sure that at least no water is running through the branch of plumbing serving this outlet. This sample is representative of the water that is in the plumbing upstream from the point where the faucet's connecting pipe joins the plumbing lateral.

Interpreting the test results

If the lead level in Sample 1F is higher than that in Sample 2F: the source of lead is the water faucet and/or the plumbing immediately upstream from the faucet.

If the lead level in Sample 2F is very low (less than 5 µg/L): most or all the lead in the water is from the faucet and/or the plumbing connecting the faucet to the lateral, and very little lead is from the plumbing farther upstream from the faucet.

If the lead level in Sample 2F exceeds 10 µg/L: the plumbing farther upstream from the faucet may be contributing lead.

If lead is found in the aerator/screen debris sent for analysis: a separate investigation by a plumbing professional may be necessary to pinpoint its source and identify appropriate remedies.

Sample scenarios and remedies

Example 1:

☑ **The lead level in Sample 1F (39 µg/L) exceeds that of Sample 2F (6 µg/L):** the water faucet and/or its connecting pipe is contributing 33 µg/L of lead.
☑ **The lead level in Sample 2F (6 µg/L) is close to 5 µg/L:** most of the lead is coming from the faucet and/or the plumbing connecting the faucet to the lateral; very little is coming from the plumbing farther upstream from the faucet.

Possible Remedies: Replace the faucet with an NSF-compliant lead-free device (see Appendix 3 for information on how to meet NSF standards); replace the plumbing that connects the faucet to the lateral with lead-free materials; flush the outlet and connecting plumbing each day; install a point-of-use (POU) device that removes lead.

Example 2:

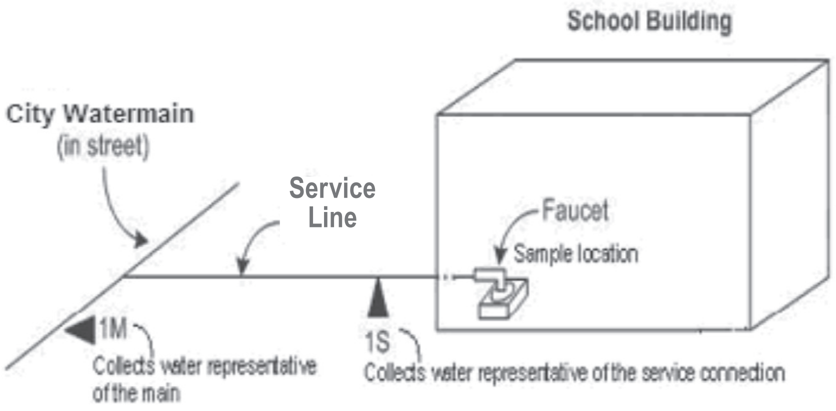
☑ **The lead level in Sample 1F (49 µg/L) exceeds that of Sample 2F (25 µg/L):** the water faucet and the plumbing immediately upstream from the outlet is the source of 24 µg/L of lead, and the plumbing farther upstream of the outlet is responsible for 25 µg/L of lead.
☑ **The lead level in Sample 2F (25 µg/L) significantly exceeds 5 µg/L:** a significant amount of the lead may be coming from upstream of the faucet.

Possible remedies: Replace the faucet with an NSF-compliant lead-free device (see Appendix 3 for information on how to meet NSF standards); replace the plumbing connecting the faucet to the lateral with lead-free materials; once you have conducted additional tests upstream from the faucet to ascertain what portions of the upstream piping might potentially be contributing lead, replace this interior plumbing with lead-free materials; flush the outlet and interior plumbing each day; install a POU device that removes lead.

The service line and watermain

You will need to compare the results of this sampling and testing to the results from outlets inside your facility to determine what specific contributions your service line and your watermain are making to lead concentrations at your facility's taps.

Figure 7: Service line, watermain and sample locations 1S and 1M


School Building
City Watermain
(in street)
Service
Line
Faucet
Sample location
1M
Collects water representative of the main
1S
Collects water representative of the service connection

Service line (see Figure 7)

Service lines are usually made of copper, galvanized steel, plastic, and/or iron. But some service lines still include lead pipes. These, or the flowmeter normally installed at the junction between the service line and the internal plumbing, can produce significant lead levels in the drinking water.

Sample 1S: Take this sample before your facility opens, from the cold water tap located as close as possible to where your building's internal plumbing is connected to your facility's service line. This is the pipe connecting your facility building(s) to the watermain in the street or to your facility's private well. It is normally a tap in the basement close to the building's shut-off valve. If your facility is large enough to be connected to the watermain through more than one service line, you will need to take samples from both. Let the water run to make sure you will be testing water in the service line, not water that has been in your facility's interior plumbing overnight. Appendix 2 provides guidance on how long to run the water before taking your 250 mL sample. Collect the sample after this flushing time.

Watermain (see Figure 7)

Sample 1M: Take this sample of the water provided by the distribution main, i.e., the watermain in the street, from the same location as sample 1S. Let the water run to make sure you will be testing water in watermain, not water that has been in your facility's interior plumbing or service line overnight. Appendix 2 provides guidance on how long to run the water before taking your 250 mL sample. Collect the sample after this flushing time.

Interpreting the test results

If the lead level of Sample 1S significantly exceeds 10 µg/L and is higher than in sample 1M: the service line is contributing the lead.

If the lead level of Sample 1M (watermain) significantly exceeds 10 µg/L: lead may be coming from source water, sediments in the main, or lead in the distribution system such as from lead joints used in the installation or repair of cast iron pipes.

If the lead levels of Samples 1S and 1M are very low (well below 10 µg/L): the service line or the distribution main are not contributing the excess lead into your system.

Sample scenarios and remedies for the service line and watermain

Example 1:

☑ **The lead level in Sample 1S (20 µg/L) exceeds that of Sample 1M (5 µg/L):** the service line is contributing 15 µg/L of lead; the lead amount in the watermain does not exceed 5 µg/L.

Possible remedy: Once you have confirmed that other outlets in your facility are not leaching excess amounts of lead, check for lead in your service line or its gooseneck, and replace if you find any.

Example 2:

☑ **The lead level in Sample 1M is 10 µg/L and Sample 1S is 10 µg/L:** the service line is contributing very little lead.

Possible remedy: The source of lead is most likely the watermain: contact your local public water supplier.

Example 3:

☑ **The lead level in Sample 1S (7 µg/L) and Sample 1M (6 µg/L) are close to 5 µg/L:** the water is picking up very little lead from the service line, the distribution main or the source water.

Possible remedy: You can rule out the service line, the distribution main and source water as sources of the problem; you will need to continue testing other locations such as outlets that show significantly higher lead levels, and/or the interior plumbing.

Interior upstream plumbing

If lead levels exceed 10 µg/L in follow-up samples taken from drinking water outlets, you will need to collect additional samples from upstream sample sites in your interior plumbing. You will likely need to take samples from one or more of the following locations, depending on use patterns in your building(s):

- **Laterals:** plumbing branches between a fixture or a group of fixtures (such as taps, water fountains, etc.).

- **Header:** the main water supply pipe, which supplies water to laterals on each floor of a building. In smaller buildings, a header may be very short, and have the same diameter as its laterals.
- **Riser pipe(s)** (where applicable): the vertical pipe(s) that carry water from the basement header to the headers (or individual laterals) on one or more floors of the building. In some buildings, the laterals are connected directly to individual riser pipes instead of floor headers.

Laterals

Follow-up Flushed Sample 1G (see Figures 2 and 3): Open the outlet you have designated as the sample location for the lateral, let the water run for 10 seconds to replace the water that has been sitting in the plumbing between the sampling location and the lateral pipe with water from the lateral pipe, and collect a 250 mL sample. You do not need to take this sample from sites where samples have already been taken as follow-up samples for another tap or fountain.

This sample corresponds to follow-up flushed samples from other outlets, such as Samples 2A, 2C and 2F.

Compare the results of these samples from outlets upstream and downstream of Sample 1G for additional information on the source of the lead within the interior plumbing. If the lead level in Sample 1G is much greater than 10 µg/L: collect additional samples from the plumbing farther upstream where you haven't previously taken samples – from the header that feeds the lateral, the riser pipe (if applicable), the basement header and the building's service line.

Interpreting the test results

If the lead level in Sample 1G is close or equal to the initial first draw screening sample results from a downstream outlet: this lateral and/or interior plumbing upstream from this lateral (i.e., a header, riser pipe and/or basement header), and/or the building's service line is contributing the lead.

If the lead level of Sample 1G is 5 µg/L or less: the main source of lead is downstream from this location. The portion of the lateral upstream from this sample location and the rest of the upstream plumbing (including the building's service line) that supply water to the lateral are not likely contributing significant quantities of lead.

If the lead level of Sample 1G is 10 µg/L or greater and is less than the initial results from a downstream outlet: the lead in the initial results from the downstream outlet likely came from plumbing downstream from Sample Location 1G as well as this lateral and/or interior plumbing upstream from the lateral (header, riser pipe, basement header), and/or the building's service line.

Headers

Follow-up Flushed Sample 1H (see Figures 2 and 3): open the faucet closest to the header (or riser, if there is no header on the floor) and let it run for 30 seconds, then collect a 250 mL sample. If you find any debris on tap screens, send it to a licensed laboratory for analysis along with the water samples.

If the lead level in Sample 1H is much greater than 10 µg/L: collect additional samples from the plumbing farther upstream that supplies water to the header, i.e., a riser (if applicable), the basement header or service line.

Interpreting the test results

If the lead level in Sample 1H is close or equal to the initial first draw screening sample results from a downstream outlet: the header and/or the interior plumbing upstream from the header (the riser pipe, basement header) and/or the building's service line is/are contributing the lead.

If the lead level in Sample 1H is equal to or less than 5 µg/L: most of the lead is coming from downstream of Sample Location 1H. The portion of the header upstream from Sample Location 1H and the rest of the upstream plumbing supplying water to the header are probably not contributing lead.

If the lead level in Follow-up Flushed Sample 1H is 10 µg/L or greater and is less than the initial results from a downstream outlet: the plumbing downstream from Sample Location 1H as well as from this header and/or interior plumbing upstream from the header (riser pipe, basement header), and/or the building's service line could be responsible for the lead concentration in the initial results from the downstream outlet.

Riser Pipes

Follow-up Flushed Sample 1J (see Figures 2 and 3): Open the tap closest to the riser pipe, let the water run for 30 seconds, then collect a 250 mL sample. If you find any debris on tap screens, send it to a licensed laboratory for analysis along with the water samples.

If the lead level in Sample 1J is greater than 10 µg/L: collect additional samples from the plumbing farther upstream that supplies water to the riser, i.e., the basement header or the service line.

Interpreting the test results

If the result for the Follow-up Sample 1J is close or equal to the initial first draw screening sample results from a downstream outlet: the riser pipe and/or the interior plumbing upstream from the riser pipe (basement header) and/or the service line are contributing the lead.

If the lead level in Sample 1J equals 5 µg/L or less: the main source of lead is downstream from the Sample Location 1J. The portion of the riser upstream from Sample 1J and the rest of the upstream plumbing supplying water to the riser are probably not contributing lead.

If the lead level in Sample 1J is 10 µg/L or greater, and is less than the initial results from a downstream outlet: the plumbing downstream from Sample Location 1J, this riser pipe and/or interior plumbing upstream from the riser pipe (basement header), and/or the building's service line could be responsible for the lead concentration in the initial results from the downstream outlet.

Sample scenarios and remedies for interior upstream plumbing

Where further sample collection is recommended, use Appendix 2 to determine how long you will need to flush.

Example 1:

- ☑ **The lead level in Sample 1G (22 µg/L) exceeds 20 µg/L:** you will need to collect additional samples from the plumbing upstream to further pinpoint the source of lead (i.e., from the service line, the riser pipe, the loop, or the header supplying water to the lateral).
- ☑ **The lead level in Sample 1G (22 µg/L) significantly exceeds 5 µg/L and is less than a downstream site or sites (35 µg/L):** somewhere downstream from the sample site is contributing a portion of the lead (13 µg/L); the rest (22 µg/L) comes from the lateral and/or other upstream locations.
- ☑ **The lead level in Sample 1G (22 µg/L) is not similar to downstream site (35 µg/L), but both exceed 20 µg/L:** the lead is coming from the lateral or from interior plumbing upstream from the lateral; its possible sources could be the loop, header, riser pipe, or service line; further sampling is necessary.

Possible solution: Once you have conducted testing as recommended above to pinpoint the exact sources of lead, replace plumbing with lead-free materials and retest to ensure that this remedy is effective.

Example 2:

- ☑ **The lead level in Sample 1H or 1J (23 µg/L) exceeds 20 µg/L:** collect additional samples from the plumbing upstream supplying water to the loop or header, and compare the results with those taken from the service line or riser pipe that supplies water to the loop and/or header.
- ☑ **The lead level in Sample 1H or 1J (23 µg/L) significantly exceeds 5 µg/L, and Sample 1H or 1J is insignificantly less than the downstream site (25 µg/L):** the lead is coming from the header or the plumbing upstream of the header, and only an insignificantly small portion of the lead (2 µg/L) is coming from downstream of the sample site.

Possible solution: Once you have conducted testing as recommended above to pinpoint the exact sources of lead, replace the affected plumbing with lead-free materials.

Example 3:

- ☑ **The lead level in the downstream site is 25 µg/L, that of Sample 1S is 4 µg/L, and that of Sample 1J (6 µg/L) is less than 20 µg/L:** there's no need to collect additional samples from upstream, because 19 µg/L of lead has come from the downstream site.
- ☑ **The lead level in Sample 1J (6 µg/L) is close to 5 µg/L:** the source of lead is downstream of the sample site, and the portion of the riser pipe and plumbing upstream from Sample Site 1J and the service line are not contributing significant amounts of lead to the water.

Possible remedies: After you collect and test samples from the interior plumbing downstream from the riser pipe and the affected outlet to pinpoint the source of lead, replace the affected plumbing with lead-free materials.

Step 4: Take routine, interim and permanent measures

You should begin taking measures to control identified lead problems on an interim (short-term) basis while waiting for the additional test results or until you can implement a permanent solution.

Then, once you have pinpointed the exact source(s) of the lead within your facility and determined, through testing, that your drinking water no longer reflects excessive levels of lead, it’s advisable to use routine control measures to prevent excessive levels of lead from creeping up again in your drinking or cooking water. Indeed, you should take routine control measures at all times, even after a permanent solution is put in place.

In addition, a number of permanent measures are advisable.

Routine control measures

To prevent exposure to elevated levels of lead:

- **Keep screens/aerators clean.** The debris collected on screens can be a source of additional lead contamination. Once you have tested the debris and confirmed the presence of lead, create and implement a routine maintenance program to clean the screens/aerators frequently.
- **Heat up water from the cold water tap on a stove or in a microwave oven** for food and beverage preparation, rather than using hot water from the tap. Hot water dissolves lead more quickly than cold water and is likely to contain increased lead levels.

Interim (short-term) control measures

Flush the piping system in your facility. The degree to which flushing helps reduce lead levels can vary, depending upon the age and condition of the plumbing and the corrosiveness of the water. But this is still the quickest and easiest measure to reduce high lead levels, especially when contamination is localized in a small area or in a small building.

Flushing of the schools’ and day nurseries’ plumbing before the students/children arrive is a legal regulatory requirement for schools and day nurseries. When applicable, you must follow the regulated flushing protocol.

In general, in the morning before your facility opens, open the last tap/faucet (not a fountain) on each run or branch of plumbing, and let the water run for at least five minutes. The actual amount of time you will need to flush a particular tap depends on the type of tap and its location within the plumbing (distance from the watermain in the street). For best results, calculate the volume of the plumbing and the flow rate at the tap, and adjust the flushing time accordingly (see Appendix 2).

After the end-of-run taps are flushed, you will need to flush, for at least 10 seconds, all other outlets within your facility that can provide cold water and may be used for drinking by children under 18 years of age.

Here are a few additional recommendations for flushing specific types of non-end-of-run outlets:

- **Drinking water fountains without refrigeration units:** Let the water run for at least 15 seconds, or until water is cold.
- **Refrigerated water fountains:** Let the water run for 15 minutes. If it is not feasible to flush these for such a long time, consider replacing these outlets with lead-free, NSF-approved devices (see Appendix 3 for information on how to meet NSF standards).
- **All kitchen faucets and other faucets where water may be used for drinking (including bathroom faucets where it is possible to obtain cold water):** Let the water run for at least 10 seconds or until water is cold.
- **Be careful not to flush too many taps at once.** This could dislodge sediments that might create further lead problems, or could reduce pressure in the system below safe levels. If the flow from outlets is reduced noticeably during flushing, you are probably turning on too many taps at once.
- **To save water,** thoroughly flush several designated drinking water outlets daily while taking all others temporarily out of service. Replace cold and hot water taps in washrooms with automatically pre-mixed warm-water-only faucets, which need not be flushed. Collect water being flushed and use it for non-consumptive purposes.
- **Flushing is not a practical remedy for water coolers.**

Provide bottled water. This can be expensive, but might be worth considering if widespread contamination is a possibility or reality, and flushing is not sufficiently reducing the lead concentrations. If you opt for bottled water, get a written guarantee from its distributor that the bottled water meets federal standards.

Temporarily shut off problem outlets. If initial sample results from an outlet exceed 20 µg/L, shut it off or disconnect it until the problem is resolved.

Permanent remedies

These are actions you can take to permanently reduce or eliminate the sources of lead that originate in your facility's plumbing. You'll need to base your decision on factors such as the extent and severity of the lead problem in your facility, the cost and likelihood of success of a particular remedy, availability of water, and staffing requirements.

Replace outlets or other components. If your facility's sources of lead contamination are localized and limited to a few outlets, the most practical solution might be to replace these outlets or upstream components with those that meet NSF standards (see Appendix 3 for information on how to meet NSF standards). If you need to replace many bubbler valves or other specific components, purchase and install only one or two initially. Take follow-up water samples(s) to confirm that that particular product does not leach unacceptable levels of lead before purchasing this component for other locations.

If you need to replace lead pipes, you, as the property owner, would normally be responsible for replacing the portion of a lead service line located on your facility's property. You can replace lead pipes within the property and arrange for the replacement of the portions of the lead service lines under the public water supplier's jurisdiction (check with the public water supplier).

Reduce lead levels at the tap. Point-of-use (POU) devices such as reverse osmosis units can effectively remove lead from drinking water at faucets or taps; they are not for drinking water fountains. Since these devices also tend to make the water corrosive to the lead in the pipe material, they should only be used when placed at water outlets. Use only filters certified to NSF standards for lead removal (see Appendix 3 for information on how to meet NSF standards), and adhere to the manufacturer's recommended equipment maintenance schedule.

Check grounding wires. If any of your electrical equipment is grounded to water pipes, the electric current travelling through the ground wire could be accelerating the corrosion of lead in your plumbing. Ask your local building inspector whether the building codes will allow you to remove existing wires already grounded to the water pipes, and replace them with an alternative grounding system. Hire a qualified electrician for this job: removing grounding from water pipes can create a shock hazard unless an acceptable, alternative ground is provided.

Reconfigure plumbing. Once you are certain of the sources of lead contamination, you may be able to modify your plumbing system to redirect drinking or cooking water so it bypasses the sections of plumbing that are the source of lead contamination. You will need follow-up testing to ensure that this really does reduce lead levels at the tap.

Set up automatic flushing for the main pipes. You can install and set time-operated solenoid valves to automatically flush some or all of the outlets that you are required to flush. For facilities that have a legal regulatory requirement for flushing, every flushing by an automatic flushing device must be verified, and the name of the person verifying that the flushing took place must be recorded along with the flushing information.

Use lead-free materials. Work closely with plumbers and other persons who repair or replace your facility's plumbing system to make sure they use only "lead-free" solders and other materials. Report any violations of the "lead-free" requirements to the plumbing inspector.

Shut off problem outlets. If initial sample results from an outlet exceed 10 µg/L, and if you don't use that outlet frequently, you can shut off or permanently disconnect the outlet.

Appendix 1: Glossary of terms

Bubbler: An outlet fixture consisting of a bubbler valve, bubbler receptacle and all associated piping, valves and mounting appurtenances for attaching the fixture to a wall or mounting surface. Some bubblers are attached to central chiller units, while others are not. None contain a refrigeration unit.

Bubbler valve: The valve and discharge device that mounts on top of the bubbler fixture and discharges water for consumption.

Chiller: A central refrigeration unit that provides cold water to some types of bubblers.

Corrosion: The dissolving and wearing away of metal caused by a chemical reaction, such as a reaction between water and piping the water contacts.

Drinking water fountain: A fixture connected to the water supply that provides water as needed. There are four types of drinking water fountains – bubblers without central chillers, bubblers with central chillers, water coolers and bottled water dispensers.

Faucet (tap): A valved outlet device attached to a pipe that normally serves a sink or tub fixture. A faucet discharges hot and/or cold water for consumption, including drinking, cooking, and washing.

Fittings: Static parts used to join sections of pipe or to join pipe to outlet fixtures.

Flux: A substance applied during soldering to facilitate the flow of solder. Because flux often contains lead, it can be a source of lead contamination in water.

Header: The main pipe in the internal plumbing system of a building. The header supplies water to lateral pipes.

Lateral: A plumbing branch between a header or riser pipe and a fixture or group of fixtures. A lateral may or may not be looped. Where more than one fixture is served by a lateral, there are connecting pipes between the fixtures and the lateral.

Outlet: A location where users can access water for drinking or cooking, such as a drinking fountain, water faucet or tap.

Passivation: A corrosion control technique wherein pipe materials create metal-hydroxide-carbonate compounds that form a protective film on the pipe wall.

Potable water pipes: The pipes which carry water intended for human consumption in a distribution system and in a building.

Public water system: A drinking water system subject to regulatory requirements under the Safe Drinking Water Act, 2002.

Riser: The vertical pipe that carries water from one floor to another.

Sediment: Matter from piping or other water conveyance device that settles to the bottom of the water. Lead sediments can form if lead components are used in plumbing materials, and result in elevated water lead levels.

Service line: The pipe that carries water from the public watermain to a building. In the past, these were often comprised of lead materials.

Service connection: The point where a building's service line is connected to the public watermain.

Source water: Untreated water from streams, rivers, lakes, or underground aquifers, used to supply private and public drinking water systems.

Solder: A metallic compound used to seal the joints between pipes.

Valves: Mechanical devices that include a movable part that opens, shuts, or partially obstructs.

Water cooler: Any mechanical device affixed to drinking water supply plumbing that actively cools water for human consumption. The reservoir can consist of a small tank or a pipe coil.

Appendix 2: How long to flush?

When you are testing your upstream plumbing, you will need to estimate the amount of time to wait before you take a follow-up flushed water sample. This time can vary, depending on the pipe size and water flow rate you will use during flushing. Some of the ways to determine how to long wait include:

- calculating the pipe volume, in litres, between the outlet and the location in the plumbing that a water sample is to represent
- measuring the outlet flow rate in litres per minute
- dividing the pipe volume in litres by the outlet flow rate in litres per minute.

The following chart can assist you in these calculations.

Pipe volumes (per metre of pipe length) for different sizes of copper pipe

Nominal pipe diameter in millimetres (inches)	Approximate Capacity (litres of water per metre of length)	
	Type K Copper (soft)	Type L Copper (rigid)
9.53 (3/8)	0.0818	0.0930
12.70 (1/2)	0.1401	0.1500
19.05 (3/4)	0.2802	0.3112
25.40 (1)	0.5010	0.5320
31.75 (1¼)	0.7837	0.8097
38.10 (1½)	1.1098	1.1458
50.80 (2)	1.9418	1.9927
63.50 (2½)	2.9909	3.0740
76.20 (3)	4.2755	4.3871

Appendix 3: How to meet NSF standards

If you need to replace fixtures or any other drinking water system products, you will need to make sure they are NSF compliant or have an American National Standards Institute (ANSI) 61 certification. NSF International – an independent, third-party testing organization – developed this voluntary industry standard in cooperation with the United States, Canada and the plumbing industry, to minimize the amounts of lead leached from products.

NSF Standard 61, Section 4 covers pipes, fittings and small drinking water storage devices with domestic or residential applications, including the products or water contact materials of pipes, fittings, tubing, hoses, well casings, drop pipes and screens.

NSF Standard 61, Section 8 covers inline mechanical devices used to measure or control the flow of water in a building. They are generally installed on service lines or building distribution systems downstream of the watermain and before endpoint devices, such as water meters, building valves, check valves, meter stops, valves and fittings and backflow preventers.

NSF Standard 61, Section 9 covers endpoint devices such as kitchen and bar faucets, lavatory faucets, water dispensers, drinking fountains, water coolers, glass fillers, residential refrigerator ice makers, supply stops, and endpoint control valves.

Further information and product listings are at www.nsf.org/business

Appendix 4: Plumbing assessment survey

You should take this survey with a facility plumbing map on hand.

These questions will help you pinpoint the source of the lead	Your Answer (circle one; where locations are required, please circle it on a map of your facility)
1. Was your original building constructed before January 1990?	Before January 1990 After January 1990
Does your building still have and use all or parts of its original plumbing?	Yes No
Have any parts of the building's plumbing infrastructure been replaced?	Some parts of the plumbing have been replaced. Locations:
Were any buildings or additions added to your original facility?	No Yes: you'll need to complete a separate plumbing profile for each building, addition, or wing
2. Was your building built or repaired after 1990?	Yes No
If so, what type of pipes and solder were used?	"Lead-free" pipe locations:
Were they lead-free (pipes, pipe fittings, fixtures) not more than 8% lead; solder and flux not more than 0.2% lead?	"Lead-free" (i.e., tin-antimony) solder and flux locations: Other locations:
3. When and where have you had recent plumbing repairs?	Year when you had repairs in Location A: Year when you had repairs in Location B: (etc.)
Was lead soldering used for these repairs?	Yes No

4. Survey your building for exposed pipes, preferably accompanied by an experienced plumber, and determine the composition of the potable water pipes serving your facility. Write down the location of each different type of pipe, the direction of water flow through the building from that pipe, the areas of the building that receive water first, and which areas receive water last.	Lead pipes: location and where the water goes: Galvanized metal: Location and where the water goes: Copper: Location and where the water goes: Plastic: Location and where the water goes: Cast iron: Location and where the water goes:
5. Do you have tanks in your plumbing system, such as pressure or gravity storage tanks? Note their location and any available information, such as manufacturer and date of installation.	Pressure tanks Information: Gravity storage tanks Information: Other
6. Do you have brass or bronze fittings, faucets, or valves in your drinking water system? Mark the locations on a diagram of your facility with notes for future analysis of lead sample results.	No Yes: Location (s):
7. Note the number and, on your facility map, the locations of any of the following outlets that provide water for consumption: • kitchen taps • drinking fountains or taps • washroom taps that permit users to obtain cold water	Kitchen taps: Number and location Drinking fountains or taps: Number and location Washroom taps that permit users to obtain cold water (which can be used as drinking water): Number and location

8. Where does the water service line (the pipe that carries drinking water from a public watermain to your facility) enter your building and connect to the interior plumbing? What is the service line made of?	Location: Service line is made of lead piping: (check for the presence of lead where the service line comes out of the wall by the building's shut-off valve by scratching it with a knife or key. Lead is dull grey coloured, easily scratched by a knife or key, and shiny when scratched) Service line is made of (other):
9. Standard faucets usually have screens or aerators. Note the locations of all outlets with where these screens or aerators are accessible, and whether these screens have been cleaned. If there is a regular maintenance schedule for cleaning these screens, what is it? Are particles and other materials often found on these screens?	Outlet 1 with accessible screen/aerator: Location Cleaned/not cleaned Maintenance schedule Debris Outlet 2 with accessible screen/aerator: Location Cleaned/not cleaned Maintenance schedule Debris etc.
10. Note the locations of any signs of corrosion, such as frequent leaks or fixture staining. Also note locations where there have been complaints of laundry or dishes staining.	Location 1: Location 2: Location 3: etc.
11. Note the locations of any electrical equipment grounded to water pipes.	No Yes Location(s):
12. Have there been any complaints about bad (metallic) taste or rust-coloured water? If so, note the locations.	No Yes Location(s):

13. Do you have any known plumbing issues such as dead ends, low use areas, existing leaks or other problem areas? Are you planning renovations for part or all of the plumbing system?	No Yes: Note the direction of water flow and the location of fixtures, valves, tanks, areas of debris accumulation, areas of corrosion, etc., on a sketch or blueprint of the plumbing.